Year 9 Biology
Distance Learning Quiz and Learn Booklet
Summer 2

Name :

Form :
Guidance
Scientists have proven that when we do not use information we know, the pathways in our brain actually decay (breakdown) - this is what happens when we forget something.
By engaging with your study (reading and doing quizzes) you are not just learning new information you are actually holding on to the information you have already have!

Well done on all the work you have done to this point, you are not letting all your hard school work and study go to waste! 😊

This booklet has contains:
- Information for you to read and make notes on
- Practice questions and answers for you to complete and self mark
- Paper copies of the online quizzes that all other students will be taking.

There are a couple of methods to submit your paper quiz
• -If you can, drop it off in the post box in the school reception
• -Take a picture and email it to your teacher

Your responses in this quiz allows your teacher to give you specific instructions on how to improve, only by doing this can we make sure you make the progress you deserve!

If you have any questions please email your teacher.
**Week 1 (1st June): Cells and systems**

**Key Points**
- Cells are the basic units of life.
- Cells are organized into tissues and organs.
- Cells have different functions and structures.
- Understanding cells is crucial for understanding life processes.

**Study Tip**
- Focus on the structures and functions of different types of cells.
- Review the concept of cell membranes and their importance.

**Simplistic Ideas**
- Magnifying and Resolving Power
  - Microscope x 200: Can see 200x the size of a hair.
  - Microscope x 500: Can see 500x the size of a hair.

**Learning Objectives**
- Understand the basic structure and function of cells.
- Recognize the importance of cellular organization in life processes.
- Study the microscope and its role in cellular observation.

**Transport**

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Week 1 (1st June): Cells and Systems

Key Points

1. Cells are the basic units of all living things.
2. There are two main types of cells: plant and animal.
3. Plant cells have a cell wall, while animal cells do not.
4. Cells contain organelles that perform specific functions.
5. The nucleus is the control center of the cell.

Study Tip

- Focus on understanding the structure and function of cells.

Go Further

- Explore the history of cell theory.
- Learn about the cell membrane and its role.

Study Tip

- Review the importance of cell organelles in different cells.

Study Tip

- Remember that plants require sunlight for photosynthesis.

Bi.2 Animal and plant cells

Plant cells - Structure and Function

- Plant cells contain a cell wall, chloroplasts, and other organelles.
- The cell wall provides support and protection.
- Chloroplasts perform photosynthesis.

Animal cells - Structure and Function

- Animal cells lack a cell wall and chloroplasts.
- They have a nucleus and mitochondria.

Learning Objectives

- Understand the basics of cell structure.
- Differentiate between plant and animal cells.
- Explore the functions of cell organelles.
Week 1 (1st June): Cells and systems

Key Points

- Cells and prokaryotic cells
- Eukaryotic cells and their functions

Study Tip

- Learn the structures and functions of cells

Go Further

- Explore the biological processes in cells

Week 1 (1st June): Cells and systems

Eukaryotic cells and prokaryotic cells

- Eukaryotic cells
- Prokaryotic cells

Learning Objectives

- Understand the differences between eukaryotic and prokaryotic cells
- Compare and contrast the structures of eukaryotic and prokaryotic cells

Some eukaryotic cells are familiar because they occur directly in humans and other animals. Some prokaryotic cells are also familiar because they occur directly in humans and other animals. Some eukaryotic cells are not familiar because they occur directly in humans and other animals. Some prokaryotic cells are not familiar because they occur directly in humans and other animals. Some eukaryotic cells are familiar because they occur directly in humans and other animals. Some prokaryotic cells are not familiar because they occur directly in humans and other animals. Some eukaryotic cells are not familiar because they occur directly in humans and other animals. Some prokaryotic cells are not familiar because they occur directly in humans and other animals. Some eukaryotic cells are familiar because they occur directly in humans and other animals. Some prokaryotic cells are not familiar because they occur directly in humans and other animals. Some eukaryotic cells are not familiar because they occur directly in humans and other animals. Some prokaryotic cells are not familiar because they occur directly in humans and other animals.
Plant and animal cells

How different types of animal cell are adapted to carry out their function

There are many different types of cells in animals. Each type is specialised for a particular role. These ensure that the organism functions as a whole.

The head of the sperm contains the genetic material for fertilisation. The acrosome in the head contains enzymes so that the sperm can penetrate an egg. The middle piece is packed with mitochondria to release energy needed to swim and fertilise the egg. The tail enables the sperm to swim.

The nerve cell is extended, so that nerves can run to and from different parts of the body to the central nervous system. The cell has extensions and branches, so that it can communicate with other nerve cells, muscles and glands. The nerve cell is covered with a fatty sheath, which insulates the nerve cell and speeds up the nerve impulse.

How different types of plant cells are adapted to their function

There are many different types of cells in plants. Each type is specialised to do a particular role and ensures that the organism functions as a whole.

The root hair cell has a large surface area to provide contact with soil water. It has thin walls so as not to restrict the movement of water.

There are no top and bottom walls between xylem vessels, so there is a continuous column of water running through them. Their walls become thickened and woody. They therefore support the plant.

Dissolved sugars and amino acids can be transported both up and down the stem. Companion cells, adjacent to the sieve tubes provide energy required to transport substances in the phloem.
# B1.1 The world of the microscope

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
</table>
| 1 a             | **advantages**
relatively cheap, can be used almost anywhere, magnification up to around \( \times 2000 \)
**disadvantages**
limited magnification and resolution | 1     |
| 1 b             | **advantages**
high magnification (up to around \( \times 2\,000,000 \)), high resolution, can give 3D images
**disadvantages**
expensive, can only be used in temperature, pressure, and humidity-controlled rooms | 1     |
| 2 a             | Size of real object = \( \frac{\text{size of image}}{\text{magnification}} \)  
capillary diameter = \( \frac{5}{1000} \)  
= 0.005 mm  
= 5.0 \( \mu \text{m} \) | 1     |
| 2 b             | Magnification = \( \frac{\text{size of image}}{\text{size of real object}} \)  
magnification = \( \frac{800}{20} \)  
= \( \times 40 \) | 1     |

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
</table>
| 3               | **Electron microscopes**
may magnify up to around \( \times 2\,000,000 \)  
have a resolving power of about 10 nm (scanning electron microscope)  
or 0.2 nm (transmission electron microscope)  
may be used to examine subcellular structures (e.g., chromosomes during cell division)  
**light microscopes**
may magnify up to around \( \times 2\,000 \)  
have a resolving power of about 200 nm  
may be used to look at cells dividing (e.g., stained onion cells) | 1     |

# B1.2 Animal and plant cells

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
</table>
| 1 a             | Nucleus  
cytoplasm  
cell membrane  
mitochondria  
ribosomes | 1     |
| 1 b             | Cell wall  
chloroplasts  
permanent vacuole | 1     |
| 1 c             | Cell wall strengthens cell and provides support.  
Chloroplasts for photosynthesis.  
Permanent vacuole keeps cells rigid to support plant. | 1     |
| 2               | **Nucleus**
controls all cell activities  
contains instructions for making new cells or new organisms  
**mitochondria**
site of aerobic respiration  
releasing energy for the cell | 1     |
| 3               | **Any two from:**
- root cells – no exposure to light  
- cells in centre of tree trunk – no exposure to light  
- cells in flowers of plants – their function is not to photosynthesise | 4     |
### B1.3 Eukaryotic and prokaryotic cells

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Genetic material in a prokaryotic cell isn’t contained in a nucleus, and may include extra rings of DNA (plasmids) separate from main genetic material</td>
<td>1</td>
</tr>
<tr>
<td>1 b i</td>
<td>long protein strand that lashes about</td>
<td>1</td>
</tr>
<tr>
<td>1 b ii</td>
<td>movement</td>
<td>1</td>
</tr>
</tbody>
</table>
| 2 a             | small animal cell length around 10 µm \[
\frac{10}{6} = 1.7\]
Length of small animal cell is same order of magnitude as cell nucleus.                                                                 | 2     |
| 2 b             | large plant cell length around 100 µm \[
\frac{100}{6} = 16.7\]
Length of large plant cell is an order of magnitude \(10^1\) bigger than cell nucleus.                                                                 | 2     |
| 3               | All cells have cell membranes and cytoplasm and both prokaryotes and eukaryotes can have cell wall. Prokaryotes have no nucleus and no chloroplasts whilst eukaryotes have no plasmids.                  | 1     |
Week 2 (8th June): Cell division

The cell cycle

The cell cycle is the process that cells undergo to divide and reproduce. It consists of two main phases: G1 (Gap 1), S (Synthesis), G2 (Gap 2), and M (Mitosis). The cell cycle is regulated by cell cycle control mechanisms, which ensure that the cell is ready to divide and that the DNA is intact before proceeding to the next phase.

The cell cycle is divided into two main phases: interphase and mitosis.

Interphase:
- G1: The cell grows and carries out its functions.
- S: DNA replication occurs.
- G2: The cell prepares for mitosis.

Mitosis:
- M: The cell divides into two new cells.

The cell cycle is essential for the growth and repair of tissues and organs and is crucial for the development of embryos. It is also a key factor in cancer development, as cancer cells often have defects in their cell cycle control mechanisms.

Key Notes:
- Cell division is important for growth, repair, and reproduction.
- Cells can divide in two ways: mitosis (equally divided daughter cells) and meiosis (unequally divided daughter cells).
- The cell cycle is controlled by cell cycle control mechanisms, which ensure that the cell is ready to divide and that the DNA is intact before proceeding to the next phase.
- Interphase is divided into G1, S, and G2 phases.
- Mitosis is divided into prophase, prometaphase, metaphase, anaphase, and telophase phases.
- The cell cycle is essential for the growth and repair of tissues and organs and is crucial for the development of embryos.

Study Tip:
- Make sure you understand the different phases of the cell cycle and how they are regulated.
- Practice drawing diagrams of the cell cycle to help solidify your understanding.
- Review the key points on cell cycle control mechanisms and how they ensure that the cell is ready to divide.

Learning Objectives:
- Identify the different phases of the cell cycle.
- Describe the processes that occur during each phase of the cell cycle.
- Explain the importance of cell division in growth, repair, and reproduction.
Week 2 (8th June): Cell division

Key points

- Cell division is the process by which a cell replicates its DNA and splits into two or more daughter cells.
- It is essential for growth, repair, and reproduction of organisms.
- There are two main types of cell division: mitosis and meiosis.

**Mitosis**

- Occurs in somatic cells (non-reproductive cells).
- Ensures the daughter cells have identical DNA contents.
- Results in the formation of two genetically identical cells.

**Meiosis**

- Occurs in reproductive cells (sperm and egg).
- Results in the formation of four genetically diverse cells.
- It is the process that leads to the formation of gametes.

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Differentiation and development of animal cells

Differentiation is the process by which cells specialize to perform specific functions. This is a critical aspect of development, as it allows for the formation of complex structures and the specialization of cells into different types. The process involves the activation of specific genes that control the expression of proteins necessary for the specialized functions of each cell type. This differentiation is crucial for the proper functioning of the organism as a whole, as each cell type has a unique role in the organism's physiology and behavior.
Week 2 (8th June): Cell division

**Key points**

- The study of cell division is crucial to understanding the growth and development of living organisms.
- Cell division is a fundamental process in all multicellular organisms, allowing for growth, repair, and reproduction.
- Understanding cell division helps in the study of genetics, as it is involved in the distribution of genetic material to daughter cells.

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**Main content**

**Learning Objectives**

1. **Differentiate between mitotic and meiotic cell division.**
2. **Describe the stages of mitosis and meiosis.**
3. **Understand the role of chromosomes and the spindle apparatus during cell division.**
4. **Explain the importance of cell division in the growth and development of organisms.**

**Cell Division**

Cell division is a process by which one cell divides into two or more cells. There are two main types of cell division: mitosis and meiosis.

- **Mitosis** is a process of cell division that results in two daughter cells where each has the same number of chromosomes as the parent cell. This type of cell division is responsible for growth and repair in multicellular organisms.
- **Meiosis** is a type of cell division that results in the production of sex cells (gametes) with half the number of chromosomes as the parent cell. This is essential for sexual reproduction, as it allows for the fusion of two genetically different cells to produce offspring with a unique combination of genetic material.

**Cell Cycle**

The cell cycle is the continuous process by which cells grow and divide. It consists of two main phases: interphase and the division phase (mitosis and meiosis). Interphase is the time when cells are not dividing and are preparing for division.

- **Interphase** is divided into three stages: G1, S, and G2. During G1, the cell grows and carries out its normal functions. In S, DNA replication occurs, and the cell prepares to divide. G2 is a final check before the division phase begins.
- **Mitosis** is the division phase and is further divided into four stages: prophase, metaphase, anaphase, and telophase. Each stage involves specific changes in the cell, including the separation of染色体 and their distribution to daughter cells.

**Chromosomes**

Chromosomes are structures that carry genetic information. During cell division, these chromosomes must be accurately separated and distributed to ensure the correct genetic makeup of the daughter cells.

**Spindle Apparatus**

The spindle apparatus is a structure that forms during mitosis and meiosis to help in the separation of chromosomes. It is composed of microtubules and is responsible for pulling chromosomes to opposite poles of the cell.

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**Further Reading**

- ** textbooks on biology**
- **online resources and articles**
- **scientific journals**

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**Interactive Learning**

- **Cell Division Simulation**
- **Interactive Diagrams**
- **Video Tutorials**

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**Review Questions**

1. What is the difference between mitosis and meiosis?
2. How many chromosomes are in a mature gamete?
3. What is the role of the spindle apparatus in cell division?

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**Further Exploration**

- **Microscopy of cell division**
- **Genetic experiments**
- **Biotechnology and cell division**

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**Conclusion**

Understanding cell division is essential for many fields of biology, including genetics, development, and biotechnology. By studying the process of cell division, we gain insights into the fundamental mechanisms that govern the growth and development of living organisms.
Week 2 (8th June): Cell division

**Key Points**

1. **Purpose of Cell Division:**
   - Cell division is essential for growth, repair, and reproduction.
   - It ensures the maintenance of genetic material.

2. **Types of Cell Division:**
   - **Mitosis** produces genetically identical cells.
   - **Meiosis** results in gametes with reduced genetic material.

3. **Key Features of Cell Division:**
   - Cytokinesis: Division of the cytoplasm.
   - Mitosis: Division of the nucleus.

**Problems with Embryonic Stem Cells**

Embryonic stem cells are crucial for research due to their pluripotency, but they raise ethical concerns.

1. **Ethical Concerns:**
   - The source of the cells is controversial.
   - The use of embryos for research may be seen as morally acceptable.

2. **Scientific Concerns:**
   - Ethical implications in research.
   - Potential for misuse.

3. **Current Alternatives:**
   - Research on induced pluripotent stem cells.
   - The use of adult stem cells.

**Teaching Point:**

- The process of cell division is a fundamental biological process that occurs in organisms to maintain their structure and function.
- Ethical considerations surrounding stem cell research are complex and multifaceted.

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*Image: Diagram of cell division and embryonic stem cell images.*
## B2.1 Cell division

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Structures made of DNA found in pairs in the nucleus of cells that contain inherited material.</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>Small packet of information (section of DNA) that controls a characteristic, or part of a characteristic, of your body.</td>
<td>1</td>
</tr>
<tr>
<td>1 c</td>
<td>Unique chemical that makes up genetic material.</td>
<td>1</td>
</tr>
</tbody>
</table>
| 2               | **Stage 1:** chromosomes replicated and all sub-cellular structures such as mitochondria and ribosomes reproduced  
**stage 2: (mitosis)** nucleus divides to form two identical daughter nuclei  
**stage 3:** cytoplasm and cell membranes divide to make two independent cells.                                                                 | 2     |
| 3 a             | New cells needed for growth and development, and worn out or damaged cells must be replaced with identical cells. Mitosis produces cells with same chromosomes and identical genetic material, which fulfil same function as original cells. | 1     |
| 3 b             | You could lack vital genes, new cells would not work properly, organism might die.                                                                                                                      | 1     |

## B2.2 Growth and differentiation

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Process by which cells become specialised and adapted to carry out a particular function.</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>All cells in an early animal or plant embryo are unspecialised (stem cells). Differentiation fulfils organisms' requirements for different cells to carry out different roles (e.g., muscle cells, sperm cells, gut lining cells).</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>In animals, differentiation occurs during embryo development and is permanent. In plants, it occurs throughout life and can be reversed or changed.</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>order of magnitude = factor of 10 adult human has approximately $3.72 \times 10^{13}$ cells fertilised ovum is one cell adult human is around 13 orders of magnitude bigger than the original cell.</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>In plants differentiation can be reversed and mitosis induced. Conditions can be changed to induce more mitosis. Cells redifferentiate into different plant tissues needed to form a new clone plant, so plants can be cloned relatively easily. In animals differentiation cannot be reversed (cells differentiate permanently), so clones cannot be made easily. In order to make animal clones, embryos have to be cloned.</td>
<td>1</td>
</tr>
</tbody>
</table>
# B2.3 Stem cells

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td><strong>Stem cell:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>undifferentiated cell</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>with potential to divide by mitosis, differentiate, and form different specialised cells in the body</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>normal body cell:</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>specialised for a specific function</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>division by mitosis can only form cells with same specialisation.</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>bone marrow</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>embryos</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>plant meristems</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Embryonic stem cells can make any type of adult cell</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>to repair or replace damaged tissues.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Could grow organs for transplants as needed.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Organs grown from stem cells could cause fewer rejection issues if right techniques are used.</td>
<td>1</td>
</tr>
<tr>
<td>3 a</td>
<td>In research it is important as far as possible to change only one variable.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ability to produce large numbers of identical plant clones enables researchers to change a variety of different variables and see effects on genetically identical individuals.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Any differences will be due to variables under investigation, not genetic differences between plants.</td>
<td>1</td>
</tr>
<tr>
<td>3 b</td>
<td>Single rare plant specimen may not reproduce or researchers may not understand conditions needed for it to thrive.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>If specimen dies or does not make seeds, species will be lost.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cloning allows scientists time to find out about the plant and to find other specimens to introduce long-term genetic variation.</td>
<td>1</td>
</tr>
</tbody>
</table>

# B2.4 Stem cell dilemmas

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Any three from:</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>• spinal cord damage</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• diabetes</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• heart damage after heart attack</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• eyesight in the blind</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• bone and cartilage repair</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>• growing organs for transplant</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>potential to cure many currently untreatable diseases/ injuries</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>grow new organs for transplant</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>prevent organ rejection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>against:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>use of human embryos problematic for some</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>risk of side effects (e.g., cancer, viral infection)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>patients may need immunosuppressant drugs</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>development of treatments slow and expensive</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>difficult to control stem cells</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Using embryonic stem cells from umbilical cord blood and amniotic fluid (rather than embryos).</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Using adult stem cells where possible.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Developing therapeutic cloning</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>in which cells originate from patient so no reproductive embryo and no immune problems.</td>
<td>1</td>
</tr>
</tbody>
</table>
Transport in Cells

**Key Points**

1. **Diffusion**
   - Definition: The process of diffusion involves the movement of particles from an area of higher concentration to an area of lower concentration.
   - Example: Oxygen molecules move from the air into the bloodstream and then into the cells.

2. **Osmosis**
   - Definition: The movement of water molecules across a semipermeable membrane from a region of high water concentration to a region of low water concentration.
   - Example: Water crossing the cell membrane.

3. **Facilitated Diffusion**
   - Definition: The movement of molecules across a membrane with the help of a carrier protein.
   - Example: Glucose entering red blood cells.

4. **Active Transport**
   - Definition: The movement of molecules against a concentration gradient, requiring energy in the form of ATP.
   - Example: Sodium-potassium pump in nerve cells.

**Study Tip**

- Review the concepts of diffusion, osmosis, facilitated diffusion, and active transport. Understand the mechanisms and examples associated with each process.

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**Lesson 3: Diffusion**

- **Diffusion** is the process by which molecules move from an area of higher concentration to an area of lower concentration. This process is important for the exchange of nutrients, waste products, and gases between cells.

- **Facilitated Diffusion** uses carrier proteins to aid in the movement of molecules across a cell membrane.

- **Active Transport** involves the use of energy (ATP) to move molecules against a concentration gradient.

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**Lesson 3: Osmosis**

- Osmosis is the movement of water molecules across a semipermeable membrane from an area of high water concentration to an area of low water concentration.

- Understanding the principles of osmosis is crucial for understanding how cells regulate their internal environment.

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**Lesson 3: Active Transport**

- Active transport is essential for maintaining homeostasis in cells, allowing for the uptake of necessary nutrients and the removal of waste products.

- The sodium-potassium pump is a classic example of active transport, maintaining the concentration gradient of sodium and potassium ions.

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**Lesson 3: Leukocyte Chemotaxis**

- Leukocyte chemotaxis is the movement of leukocytes (white blood cells) toward a chemical stimulus.

- This process is crucial in the body’s immune response, as it allows leukocytes to migrate to sites of infection and inflammation.

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**Lesson 3: Learning Objectives**

- Understand the concepts of diffusion, osmosis, facilitated diffusion, and active transport.
- Be able to explain the mechanisms and examples associated with each process.
- Apply knowledge of diffusion, osmosis, and active transport to real-world scenarios.
Week 3 (15th June): Transport in cells

Study tip

Osmosis in animals

How does osmosis differ from diffusion?

1. In the presence of a concentration gradient, a solution of higher solute concentration diffuses across the membrane into a solution of lower solute concentration.

2. In the presence of a concentration gradient, a solution of lower solute concentration diffuses across the membrane into a solution of higher solute concentration.

Study tip

After this topic, you should know:

- The process of osmosis is driven by the concentration gradient.
- Osmosis occurs across a semipermeable membrane.
- Water moves from an area of higher solute concentration to an area of lower solute concentration.
- Osmosis is a passive process, meaning it does not require energy.
Transport in cells

**Key Points**

1. **Passive Transport**
   - Osmosis
   - Diffusion
   - Facilitated diffusion

2. **Active Transport**
   - ATP-driven
   - Ion pumps
   - Secondary active transport

3. **Nutrient Transport in Cells**
   - **Pyruvate** enters cells by facilitated diffusion.

4. **The Importance of Active Transport**
   - Carries molecules against concentration gradients.
   - Examples: Osmosis, facilitated diffusion, active transport.

5. **Moving Substances by Active Transport**
   - Thermodynamic requirements are much higher for active transport.
   - Requires energy input.

**Learning Objectives**

- Understand the principles of different transport mechanisms.
- Differentiate between passive and active transport.
- Apply the knowledge to real biological scenarios.
### B1.6 Diffusion

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spreading out of particles of a gas or a substance in solution along a concentration gradient (from area of higher concentration to area of lower concentration). This takes place as a result of random movement of particles. When particles are concentrated, there are more collisions.</td>
<td>1</td>
</tr>
<tr>
<td>2 a</td>
<td>Heating makes particles move more quickly speeding up diffusion as particles collide more often and harder and spread out faster.</td>
<td>1</td>
</tr>
<tr>
<td>2 b</td>
<td>Folded membranes provide increased surface area. The greater the surface area, the more diffusion of dissolved substances can take place across it.</td>
<td>1</td>
</tr>
<tr>
<td>3 a</td>
<td>Digested food molecules move from gut (high concentration) into bloodstream (low concentration) down a concentration gradient. Rich blood supply maintains concentration gradient.</td>
<td>1</td>
</tr>
<tr>
<td>3 b</td>
<td>Carbon dioxide moves from blood (high concentration) into air in the alveoli of the lungs (low concentration) down a concentration gradient. Rich blood supply maintains concentration gradient.</td>
<td>1</td>
</tr>
<tr>
<td>3 c</td>
<td>Chemicals produced by female moth spread out into air around her down concentration gradient. Chemicals more concentrated close to female moth (high concentration) than further away (low concentration). Male moth flies up concentration gradient; following chemical to reach female moth.</td>
<td>1</td>
</tr>
</tbody>
</table>

### B1.7 Osmosis

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>In diffusion all particles move freely down concentration gradients. In osmosis only water (solvent) molecules move across a partially permeable membrane from a dilute solution to a concentrated solution.</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>If cells use up water in chemical reactions and cytoplasm becomes too concentrated, water moves into cells by osmosis. If cells make water during chemical reactions and cytoplasm becomes too dilute, water moves out of cells by osmosis.</td>
<td>1</td>
</tr>
<tr>
<td>2 a i</td>
<td>solution with same concentration of solutes as inside of cell</td>
<td>1</td>
</tr>
<tr>
<td>2 a ii</td>
<td>solution with lower concentration of solutes than inside of cell</td>
<td>1</td>
</tr>
<tr>
<td>2 a iii</td>
<td>solution with higher concentration of solutes than inside of cell</td>
<td>1</td>
</tr>
<tr>
<td>2 b</td>
<td>If solute concentration outside body cells is more dilute than cell contents, water will move into cells by osmosis – cells will swell and may burst. If solute concentration outside body cells is higher than cell contents, water will leave cells by osmosis – cells will shrink and stop working properly. Solute concentration outside body cells must be as constant as possible to minimise changes in size and shape of cells, keeping them working normally.</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Cytoplasm of Amoeba is more concentrated than fresh water. Its cell membrane is partially permeable, so water constantly moves into Amoeba from its surroundings by osmosis. If this continued without stopping, the organism would burst. Water is moved into special vacuole by active transport, and vacuole then bursts to remove excess water</td>
<td>1</td>
</tr>
</tbody>
</table>
## B1.9 Active transport

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Useful molecule binds to transport protein in cell membrane. Transport protein changes shape and moves useful molecule across membrane into cell against concentration gradient. Useful molecule is released, transport protein returns to original position.</td>
<td>1</td>
</tr>
<tr>
<td>2 a</td>
<td><strong>Active transport:</strong> substances moved against concentration gradient across partially permeable membrane process uses energy supplied by cellular respiration. <strong>Osmosis and diffusion:</strong> substances moved down concentration gradient (diffusion) or water concentration (osmosis); no requirement for energy from respiration.</td>
<td>1</td>
</tr>
<tr>
<td>2 b</td>
<td>Cellular respiration in mitochondria releases energy needed for active transport. Cells that carry out a lot of active transport often have many mitochondria to meet their energy requirements.</td>
<td>1</td>
</tr>
<tr>
<td>3 a</td>
<td>Marine birds are exposed to salt water in the sea. They use active transport to remove excess salt from the body against a concentration gradient.</td>
<td>1</td>
</tr>
<tr>
<td>3 b</td>
<td>Plants need to move mineral ions from soil into their roots. Mineral ion solutions in soil are much more dilute than the solution in plant root hair cells, so they are moved against a concentration gradient using active transport.</td>
<td>1</td>
</tr>
</tbody>
</table>
Levels of organisation
In order of increasing complexity, multicellular organisms are made of:
cells → tissues → organs → organ systems

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organelle</td>
<td>A specialised unit within a cell which performs a specific function</td>
</tr>
<tr>
<td>Cell</td>
<td>The basic building block of all living organisms</td>
</tr>
<tr>
<td>Tissue</td>
<td>A group of cells working together to perform a shared function, and often with similar structure</td>
</tr>
<tr>
<td>Organ</td>
<td>A structure made up of groups of different tissues, working together to perform specific functions</td>
</tr>
<tr>
<td>Organ system</td>
<td>A group of organs with related functions, working together to perform certain functions</td>
</tr>
</tbody>
</table>

The need for exchange surfaces
Organisms must take in food, oxygen and water, and other essential substances, from the environment. Plants also need carbon dioxide for photosynthesis. Organisms also need to remove waste substances.

Small organisms exchange these essential and waste substances between themselves and the environment. They do this over their body surface. Simple chemical substances can diffuse in and out of their bodies.

Inside their bodies, in small organisms, substances don’t have to move far. The size of their surface, or surface area, defines how quickly they can absorb substances. The size of their volume defines how much of these substances they need.

Modelling cells
If we represent the cell of an organism by a cube:

For a 1 cm × 1 cm × 1 cm cube

<table>
<thead>
<tr>
<th>Volume</th>
<th>Surface area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cm³</td>
<td>6 cm²</td>
</tr>
</tbody>
</table>

This is what happens when the cube increases in size:

As the volume increases, surface area does not increase at the same rate.
As multicellular organisms increase in size, they face two problems:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution to the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Their surface area does not increase as fast as the volume</td>
<td>Insufficient surface area to meet their needs</td>
</tr>
<tr>
<td></td>
<td>Diffusion is not quick enough to move substances to where they’re needed in the organism’s body</td>
</tr>
<tr>
<td>Their volume increases</td>
<td>Body systems that add additional absorbing area to exchange surfaces</td>
</tr>
<tr>
<td></td>
<td>A transport system</td>
</tr>
</tbody>
</table>

Adaptations of effective exchange surfaces in all organisms

In **multicellular** organisms, surfaces and body organs are specialised for exchanging materials. The effectiveness of exchange surfaces in plants and animals is increased by having:

**A large surface area:**
- the flattened shape of structures such as leaves
- the **alveoli** in the respiratory system
- the **villi** in the digestive system

**A short distance required for diffusion:**
- the membranes of cells
- the flattened shape of structures such as leaves
- the walls of blood **capillaries** are one cell thick
- the **epithelia** of alveoli in the respiratory system and the villi in the small intestine are only one cell thick

**Animals have additional adaptations for effective exchange surfaces**

An efficient blood supply to transport molecules to and from the exchange surface increases effective exchange. Examples of this include:
- the network of blood capillaries that surrounds each alveolus in the lungs
- the network of blood capillaries in each villus in the small intestine

The process of breathing, or **ventilation**, brings air to, and removes air from the exchange surface – the alveoli. The moving blood and ventilated surfaces mean that a steep **concentration gradient** can be maintained. This increases effective exchange.

**The human gas exchange system**

The human lungs provide an **exchange surface** adapted for:
- absorbing **oxygen** – needed for respiration – into the blood from the air
- transferring **carbon dioxide** – produced by respiration – from the blood into the lungs then the air

The lungs are organs enclosed within the chest or **thorax**. Air needs to be breathed in to be brought into contact with the exchange surfaces within the lungs. This process is called **ventilation**.
The structure of the respiratory system

The human respiratory system is adapted to allow air to pass in and out of the body, and for efficient gas exchange to happen. The lungs are enclosed in the thorax, surrounded and protected by 12 pairs of ribs. The ribs are moved by two sets of intercostal muscles. There is a muscular diaphragm below the lungs. The lungs are sealed within two airtight pleural membranes. These wrap around the lungs and line the rib cage.

The trachea, or windpipe, branches into two bronchi – one bronchus to each lung. Rings of cartilage in the walls of the trachea help to keep it open as air is drawn in. The bronchi split into smaller branches and then into smaller tubes called bronchioles. Each bronchiole ends in a cluster of microscopic air sacs called alveoli.

Gaseous exchange

The exchange of gases occurs between the alveoli and blood in the capillaries that supply the lungs. Capillaries cover 70% of the outside of alveoli, providing a large surface area for gases to diffuse across.

The alveoli are adapted to provide a very large surface area for gaseous exchange:
• small size - each alveolus is a small sphere about 300 μm in diameter, giving it a larger surface area to volume ratio than larger structures
• number - there are around 700 million alveoli – ie 350 million per lung
The total surface area of the alveoli is around 70 square metres.
There is also a short diffusion path - the walls of blood capillaries and alveoli are just one cell thick. The alveoli are also lined with a thin film of moisture. Gases dissolve in this water, making the diffusion path even smaller.
The ventilation of the lungs and the blood flow through the surrounding capillaries mean gases are being removed continually, and steep concentration gradients are set up for gases to diffuse.

Gills in fish

Water is capable of holding only low concentrations of oxygen, so fish need a different type of exchange system. The exchange surfaces in fish are gills.
exchange of gases in fish is very efficient because of:
the large surface area of the gills
the large surface area of the blood capillaries in each gill filament
the short distance required for diffusion – the outer layer of the gill filaments and the capillary walls are just one cell thick
the efficient ventilation of the gills with water - there is a counter current flow of water and blood
### Practice questions

1. What is an organelle?
   - A sub-cellular structure
   - A mitochondrion
   - A group of tissues

2. Why do large, multicellular organisms need a transport system?
   - The surface area to volume ratio of their bodies becomes too large
   - Concentration gradients between areas of the body are too large
   - Distances are too large to move substances by diffusion

3. Which adaptation in plants contributes to the efficient exchange of gases?
   - They are able to ventilate their leaves
   - The flattened shape of a leaf
   - Low concentration gradients between the outside and inside of the leaf

4. Which one of the following is an adaptation to improving the efficiency of gaseous exchange?
   - Clusters of alveoli in the lungs increase the efficiency of gaseous exchange
   - The presence of rings of cartilage in the trachea
   - The fattened, globular shape of plants such as cacti

5. Which one of the following processes leads to air being breathed into human lungs?
   - Contraction of the diaphragm
   - An increase in air pressure in the lungs
   - Relaxation of the external intercostal muscles

6. In the respiratory system, which structure connects a bronchus to an alveolus?
   - Bronchiole
   - Trachea
   - Pleural cavity

7. How are blood capillaries well-adapted for gaseous exchange?
   - There are always very high concentration gradients across capillaries
   - Their walls are just one cell thick
   - The blood in them is under high pressure

8. Which one of the following is NOT a tissue?
   - Lung
   - Epithelium
   - Blood

9. Why is obtaining oxygen more difficult for a fish than a land animal?
   - Its system for gas exchange is very inefficient
   - The oxygen concentration of water is much lower than air
   - They have a poor gas exchange surfaces

10. Through which structure does oxygen-deficient water leave the body of a fish?
    - Through the mouth
    - Through the operculum
    - Through the gills
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    - Through the mouth
    - **Through the operculum**
    - Through the gills
Week 5 (29th June): Animal organisation digestion

**Key Points**

1. The digestive system is a complex network of organs and tissues that work together to digest and absorb food.
2. The process of digestion involves mechanical breakdown (chewing and mixing in the stomach) and chemical breakdown (enzymes and acids in the small and large intestine).
3. The digestive system begins with the mouth, where food is chewed and mixed with saliva, and continues through the esophagus, stomach, small intestine, and large intestine.

**Diagram 1:** The human digestive system.

**Study Tip:**

- The position of the mouth, esophagus, stomach, and small and large intestines is crucial for understanding how food travels through the digestive system.

**Learning Objectives:**

- Understanding the components of the digestive system and their functions
- Exploring the processes of digestion and absorption
- Assessing the impact of dietary choices on digestion and absorption
Animal organisation digestion

**Key points**

- The presence of protons.
- Protons are inside the cell, not outside.
- Protons are formed by the breakdown of glucose in the mitochondria.
- Protons are released in the cytoplasm.
- Protons are transported across the mitochondrial membrane.
- Protons are used to produce ATP.

**Chemicals and processes**

- **Chemicals**
  - ATP
  - Protons

- **Processes**
  - Oxidative phosphorylation
  - ATP synthesis

---

**B.3.3 The chemistry of food**

Learning objectives:

- After this topic, you should know:
- The structure of food.
- The chemistry of food.
Week 5 (29th June): Animal organisation digestion

**Key Points**

- Key themes: Tracing digestive processes, understanding the gut, enzymes and their roles.

**Study Tip**

- Consumption of nutrients: Focus on how the body breaks down food and absorbs nutrients.

**Figure 1**

- Digestion processes: Stages from intake to absorption.

**Figure 2**

- Enzyme actions: Exploring the role of enzymes in digestion.

**Figure 3**

- Organisational digestion: Schematic of the digestive system and its components.

---

**Enzymes - biological catalysts**

- How enzymes work: They speed up the rate of chemical reactions without being consumed.

---

**Learning Objectives**

- Understand the role of enzymes in digestion.

---

**B3.4 Catalysts and Enzymes**

- Catalysts and enzymes play crucial roles in chemical reactions.

---

**Microbial Reactions**

- Microorganisms utilize enzymes to break down food.

---

**Figure 4**

- Microbial digestion: Diagram illustrating the role of microorganisms in digestion.

---

**Figure 5**

- Microbial enzymes: Overview of different types of enzymes produced by microorganisms.
## B3.2 The human digestive system

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A – 3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>B – 4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>C – 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>D – 2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>An organ is a collection of several different tissues that work together to carry out a particular function (any two examples). An organ system is a number of organs working together to carry out a major function (any two examples).</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Each part of digestive system relies on preceding parts. Stomach relies on mouth, teeth, and salivary glands to deliver chunks of chewed food. Small intestine depends on stomach to continue digestive process and on enzymes made by pancreas to help with the digestive process. Large intestine can only deal with remains of food already digested in the small intestine (soluble molecules absorbed into blood, leaving waste material and water), absorbing water and removing faeces from body.</td>
<td>1</td>
</tr>
</tbody>
</table>

## B3.3 The chemistry of food

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>molecule made up of long chains of amino acids</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>structural components, hormones, antibodies, enzymes (catalysts)</td>
<td>1</td>
</tr>
</tbody>
</table>
| 2               | **similarities:**
|                 | • vital components of a balanced diet                                  | 3     |
|                 | • contain carbon, hydrogen, and oxygen                                 |       |
|                 | • large molecules made up of smaller molecules joined together         |       |
|                 | **differences:**
|                 | • carbohydrates made up of sugar units                                 | 1     |
|                 | • lipids made up of fatty acids and glycerol                           | 1     |
|                 | • proteins made up of long chains of amino acids                       | 1     |
|                 | • lipids insoluble in water                                            | 1     |
|                 | • proteins contain nitrogen                                            | 1     |
| 3 a             | iodine test                                                            | 1     |
|                 | yellow-red iodine solution turns blue-black if starch present          | 1     |
| 3 b             | ethanol test                                                           | 1     |
|                 | ethanol added to solution gives cloudy white layer if lipid present    | 1     |
| 4               | Lipids are made up of three molecules of fatty acids joined to a molecule of glycerol. Different combination of fatty acids determines whether lipid is solid (fat) or liquid (oil). | 1     |
| 5               | Complex carbohydrates are made up of long chains of simple sugars joined together. Simple sugars are basic units of complex carbohydrates. | 1     |
## B3.4 Catalysts and enzymes

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>substance that speeds up a chemical reaction but is not used up or involved in the reaction and can be used many times over</td>
<td>1</td>
</tr>
<tr>
<td>1 b</td>
<td>large protein molecule that acts as biological catalyst</td>
<td>1</td>
</tr>
<tr>
<td>1 c</td>
<td>area in structure of enzyme with unique shape that binds to specific substrate</td>
<td>1</td>
</tr>
<tr>
<td>2 a</td>
<td>protein</td>
<td>1</td>
</tr>
<tr>
<td>2 b</td>
<td>Substrate of reaction to be catalysed fits into active site of enzyme like a lock and key. Once in place, enzyme and substrate bind together. Reaction takes place rapidly and products are released from active site. Enzyme then ready to catalyse another reaction.</td>
<td>1</td>
</tr>
<tr>
<td>3 a</td>
<td>building large molecules from smaller ones changing one molecule into another breaking down large insoluble molecules into smaller soluble ones</td>
<td>1</td>
</tr>
<tr>
<td>3 b</td>
<td>Chemical reactions needed for life could not take place fast enough without enzymes to speed them up. Each reaction controlled by specific enzyme so that many metabolic reactions can take place in same small space without interfering with one another. Enzymes enable cells to perform basic reactions (e.g., respiration) and specific reactions to carry out particular functions simultaneously.</td>
<td>1</td>
</tr>
</tbody>
</table>
Week 6 (6th July): Animal organisation transport systems

**Key Points**

- White blood cells
- Platelets
- Red blood cells

---

**Figure 1:** Blood diagram with white blood cells and platelets highlighted.

**Table 1:**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify the major functions of the blood system.</td>
</tr>
<tr>
<td>2</td>
<td>Explain the role of red blood cells.</td>
</tr>
<tr>
<td>3</td>
<td>Discuss the function of the platelets.</td>
</tr>
</tbody>
</table>

---

**Platelets**

- Small, disc-shaped particles
- Involved in blood clotting
- Help prevent excessive bleeding

**Red blood cells**

- Carry oxygen from the lungs to the body tissues
- Contain hemoglobin
- Help transport carbon dioxide from the body tissues to the lungs

---

**Components of the blood**

- Red blood cells
- White blood cells
- Platelets
- Plasma

---

**The blood**

- Functions:
  - Transport of gases
  - Regulation of body temperature
  - Protection from infection

---

**Learning objectives**

- Identify the major functions of the blood system.
- Explain the role of red blood cells.
- Discuss the function of platelets.
Week 6 (6th July): Animal organisation transport systems

Key Points

- **Checkpoints of the circulatory system:**
  - The circulatory system is responsible for the transport of oxygen, nutrients, and waste products within the body.

- **Cardiac cycle:**
  - The heartbeat is controlled by the sinoatrial node, which initiates the electrical impulse that stimulates the atrial muscles to contract.

- **Double circulation:**
  - In double circulation, the heart pumps blood through two separate circuits: systemic and pulmonary.

- **The blood vessels:**
  - Blood vessels are the conduits through which blood is transported throughout the body.

Learning Objectives:

- **Blood vessels:**
  - Identify the major blood vessels in the body
  - Understand their functions

Study Tip:

- **Reading for the week:**
  - Focus on understanding the key concepts of the circulatory system and the function of blood vessels.

Figure 1: The two main types of blood vessels

![Blood Vessels Diagram](image-url)
Week 6 (6th July): Animal organisation transport systems

Key points

1. The heart is an organ that pumps blood around the body.
2. The heart is made of four chambers.
3. The heart pumps blood through the lungs and back to the body.

Study tip

Always draw a heart diagram to show how blood flows through the heart.

Figures 1 & 2. Diagrams of the heart showing how blood flows through the heart.

Problems with blood flow through the heart

- Narrowing of blood vessels
- Valve problems
- Congenital heart defects

The heart is a muscle that pumps blood around the body. It is made up of four chambers: the right atrium, right ventricle, left atrium, and left ventricle.

Learning objectives

- Understand the structure and function of the heart.
- Know how blood flows through the heart.
- Be able to identify common heart conditions.

The heat is an organ that pumps blood around the body. It is made up of four chambers: the right atrium, right ventricle, left atrium, and left ventricle.

The heart is a muscle that pumps blood around the body. It is made up of four chambers: the right atrium, right ventricle, left atrium, and left ventricle.

Learning objectives

- Understand the structure and function of the heart.
- Know how blood flows through the heart.
- Be able to identify common heart conditions.
### B4.1 The blood

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Any three from:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transport of blood cells,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transport of dissolved gases,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transport of food,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transport of hormones,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- removal of waste products,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- defence against infection,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- preventing blood loss through clotting</td>
<td></td>
</tr>
<tr>
<td>2 a</td>
<td>Blood is made up of plasma (dissolved substances in yellow liquid) in which red blood cells are suspended.</td>
<td></td>
</tr>
<tr>
<td>2 b</td>
<td>red blood cells</td>
<td></td>
</tr>
<tr>
<td>2 c</td>
<td>Any three from:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transports waste products to kidneys as urea,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transports soluble products of digestion to cells,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transports waste carbon dioxide to lungs,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- transports oxygen around body in red blood cells.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>white blood cells:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- relatively large blood cells with nuclei,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- protect against invasion of harmful microorganisms,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- some (lymphocytes) form antibodies or antitoxins,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- some (phagocytes) actively engulf and digest bacteria and viruses</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>platelets:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- fragments of larger cells with no nuclei,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- help with clotting to keep microorganisms out.</td>
<td></td>
</tr>
</tbody>
</table>

### B4.2 The blood vessels

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>carry blood away from the heart, thick wall of muscle (to contain blood under pressure) and elastic fibres (to allow stretch as blood is forced through by heartbeat as pulse)</td>
<td></td>
</tr>
<tr>
<td>1 b</td>
<td>carry blood towards the heart, relatively thin walls (blood not under pressure), have valves (to keep blood flowing towards heart)</td>
<td></td>
</tr>
<tr>
<td>1 c</td>
<td>link arteries and veins, very thin walls (to promote diffusion of substances in and out)</td>
<td></td>
</tr>
<tr>
<td>2 a</td>
<td>Arteries carry blood from heart to organs, veins return blood to heart, capillaries link arteries and veins.</td>
<td></td>
</tr>
<tr>
<td>2 b</td>
<td>Oxygen and dissolved food substances diffuse from blood into cell and waste products such as carbon dioxide diffuse out of cell into blood.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>In fish blood leaves the capillaries of the gas exchange organ slowly, at low pressure, and without a pulse. Active land mammals require lots of food and oxygen to supply muscles and organs for movement and warmth. They also produce a lot of waste materials such as carbon dioxide that must be removed. Single circulation system would not be able to supply tissues or remove waste fast enough as blood would travel around body too slowly. Double circulation system much more efficient because blood is pumped to gas exchange organ, then returns to heart and is pumped around body quickly at pressure.</td>
<td></td>
</tr>
</tbody>
</table>
## B4.3 The heart

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
</table>
| 1               | **flow chart should include:**  
deoxygenated blood from body enters right atrium through vena cava → oxygenated blood from lungs enters left atrium through pulmonary vein → atria contract together and force blood down into ventricles (lower chambers) → right ventricle sends deoxygenated blood to lungs through pulmonary artery → left ventricle pumps oxygenated blood around the body through aorta | 4     |
| 2 a             | prevent blood flowing backwards, making heart more efficient                                                                                                                                       | 1     |
| 2 b             | supply heart muscle cells with oxygenated blood for aerobic respiration and efficient contraction                                                                                                  | 1     |
| 2 c             | allows heart to pump blood around body very efficiently, enables blood to leave heart at high pressure, right ventricle only has to send blood to the lungs (where high pressure would be damaging) | 1     |
| 3               | Pulmonary artery carries blood away from heart. Blood carried from heart to lungs is deoxygenated blood from the body, which is dark red until it picks up oxygen in the lungs.                                | 1     |
| 4 a             | metal mesh placed in artery and opened up by inflation of tiny balloon to hold narrowed blood vessel open so blood can flow freely                                                                       | 1     |
| 4 b             | **Advantages:**  
Bypass surgery: very effective against severe blockages  
**Disadvantages:**  
Stent: ineffective against severely blocked or narrowed arteries  
Bypass surgery: general anaesthetic required, expensive | 1     |
Week 7 (13th July): Animal organisation digestion transport systems

Key points

Artificial Hearts

The heart is a four-chambered pump that circulates blood throughout the body. It is composed of muscle tissue that contracts rhythmically, pushing blood outwards. The heart is divided into four chambers: the right atrium and right ventricle, which pump oxygen-poor blood to the lungs, and the left atrium and left ventricle, which pump oxygen-rich blood to the body.

Learning objectives

- Understand the function and structure of the heart
- Describe the process of blood circulation
- Discuss the importance of heart health

B.4. Helping the heart

Figure 1: Artificial hearts

Go further

Additional resources on the topic:

- Artificial heart implantation
- Heart transplantation
- Heart failure and treatment options
- Heart disease prevention

Artificial pacemakers

Artificial pacemakers are used to regulate the heart rate in cases of arrhythmia or heart block. They are small electronic devices that can be implanted into the body and are activated by a pulse generator. The pacemaker detects the heart rate and sends electrical impulses to the heart to maintain a normal rhythm.

Learning objectives

- Understand the function and structure of the heart
- Describe the process of blood circulation
- Discuss the importance of heart health

Additional resources on the topic:

- Artificial heart implantation
- Heart transplantation
- Heart failure and treatment options
- Heart disease prevention

For more information, visit the following websites:

- American Heart Association
- Heart Failure Society of America
- American College of Cardiology
- American Heart Disease Foundation
Evaluation of different treatment methods
Drugs used alongside heart conditions and transplants prolong life. NHS data shows the life expectancy of heart transplant patients:

<table>
<thead>
<tr>
<th>Life expectancy in years</th>
<th>Proportion of patients, in per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1</td>
<td>80 - 90</td>
</tr>
<tr>
<td>&gt; 5</td>
<td>70 - 75</td>
</tr>
<tr>
<td>&gt; 10</td>
<td>50</td>
</tr>
</tbody>
</table>

Evaluating the treatment methods

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drugs - statins</td>
<td>Reduce the risk of heart attack. Studies have shown a decrease in 'bad cholesterol' and an increase on 'good cholesterol.' Used to reduce high cholesterol levels that have genetic causes. May have beneficial effects on other conditions.</td>
<td>Not suitable for people with liver disease. Some side effects. Must be taken for life. Should not be taken if pregnant or breastfeeding.</td>
</tr>
<tr>
<td>Heart transplant</td>
<td>Improve quality of life.</td>
<td>Few donor hearts are available. Recovery time is long. There is a risk of rejection by the body's immune system. Biological valves may wear out. Blood clots may stick to mechanical valves - anti-blood clotting drugs need to be taken.</td>
</tr>
<tr>
<td>Replacement heart valves</td>
<td>Restore blood flow through the heart.</td>
<td></td>
</tr>
<tr>
<td>Stents</td>
<td>Widen coronary arteries that have not responded to drug treatment. The recovery time is short following insertion of the stent.</td>
<td>In a minority of cases, further treatment is required.</td>
</tr>
</tbody>
</table>

Taking pulse, calculating blood flows

The pulse
The simplest way of checking heart rate is to measure your pulse. As the heart beats, a pulse can be felt in locations where an artery passes over a solid structure, such as bone. Locations include wrist, neck and upper arm. The pulse rate is expressed in beats per minute.

To measure your pulse rate, count the number of beats in a set period of time, eg 30 seconds, or a minute. In healthy people, generally, the lower the resting pulse rate, the fitter they are. Pulse rates increase during and after exercise, as more oxygen must be provided to the muscles, and carbon dioxide removed.
## B4.4 Helping the heart

<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>group of cells in right atrium of heart producing regular electrical signal that spreads through heart and makes it contract</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>electrical device implanted into chest producing regular electrical signals to stimulate heart to contract and beat, often inactive if heart beating normally and activated by change in heart rhythm may measure additional demands increase heart rate during exercise</td>
<td>1</td>
</tr>
<tr>
<td>3 a</td>
<td>Valves prevent backflow of blood in heart. Leaky valve can allow blood to flow backwards, which means full amount of blood does not leave heart and blood coming into heart chamber mixes with blood that hasn't left, making heart less efficient.</td>
<td>1</td>
</tr>
<tr>
<td>3 b i</td>
<td>advantage: lasts a long time disadvantage: lifetime medication required to prevent clotting</td>
<td>1</td>
</tr>
<tr>
<td>3 b ii</td>
<td>advantage: no medication needed disadvantage: limited lifespan (12–15 years)</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Can be used to keep patient alive until suitable heart for transplant becomes available. Can be used in some cases to rest patient’s own heart and allow it to recover. May be used to replace the natural heart in the long term. Very expensive, not effective over long periods, could be overtaken by organs grown from stem cells.</td>
<td>1</td>
</tr>
</tbody>
</table>
You should have reviewed the revision pages on the link below before completing this quiz
https://www.bbc.co.uk/bitesize/guides/z2kmk2p/revision/1

Hi James, when you submit this form, the owner will be able to see your name and email address.

* Required

1. Which of the following is the smallest? *
   (1 Point)
   - Gene
   - Cell
   - Chromosome
   - Nucleus

2. The 23rd pair of chromosomes are the sex determining chromosome- they decide whether a person is male or female. What are the sex determining chromosomes in a male? *
   (1 Point)
   Enter your answer

3. Give two reasons that cells divide by mitosis *
   (2 Points)
   Enter your answer
4. A growing and dividing cell goes through a series of stages called the cell cycle. What happens in the first stage of the cell cycle? (We learnt it as interphase in class) *(2 Points)*

Enter your answer

5. How many daughter cells are made during mitosis? *(1 Point)*

Enter your answer

6. Which of the following statements is false? *(1 Point)*

- Adult stem cells can be found in the brain
- Adult stem cells care able to become any type of cell
- Adult stem cells are found in limited numbers at certain locations around the body
- Adult stem cells from bone marrow can become blood cells and cells from the immune system

7. Where does cell division (mitosis) occur in plants? *(1 Point)*

Enter your answer

8. Compare the circulatory system and the respiratory system *(3 Points)*

Enter your answer
9. Describe how cells from the meristem can be cloned through tissue culture. There are four steps you need to include. *
   (4 Points)

Enter your answer

10. Describe one disease that is treated with human stem cells. *
    (1 Point)

Enter your answer

11. Describe some of the ethical issues that some people have with the use of embryonic stem cells (why do some people object to their use?) *
    (3 Points)

Enter your answer

Submit
Hi James, when you submit this form, the owner will be able to see your name and email address.

* Required

1

**Define the term diffusion** *(2 Points)*

Enter your answer

2

**In the alveoli of the lungs when air is first breathed in, does it have a higher concentration of carbon dioxide than the blood or lower?** *(1 Point)*

- The concentration of carbon dioxide is lower in the alveoli than the blood.
- The concentration of carbon dioxide is higher in the alveoli than the blood.
The concentration gradient is the difference between a high concentration of particles and a low concentration of particles.

Select the correct missing words from the sentence below:
“There are three forms of transport, ____________ and ____________ go down the concentration gradient and only ____________ goes against the concentration gradient” *
(1 Point)

- Osmosis, Diffusion, Active transport
- Active transport, diffusion, Osmosis
- Osmosis, Active transport, diffusion

Suggest why puppies are more at risk of losing body heat than adult dogs. *
(1 Point)

Define the term osmosis *
(3 Points)

Why do animal cells burst due to osmosis if placed a pure water (a hypotonic solution) but plant cells do not? *
(1 Point)
7

Describe the change which will occur if a piece of peeled potato is placed in a concentrated sugar solution and explain why this change occurs. (3 marks) *

(3 Points)

8

Calculate the percentage change in mass of a potato cylinder that had a mass of: 2.45g before the experiment and 3.21g after being placed in a sugar solution. *

(1 Point)

9

Plant roots obtain some of their mineral salts from the soil by active transport.

What is involved in active transport? (4 marks) *

(4 Points)
The image below shows an epithelial cell from the lining of the small intestine.
Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food. *
(1 Point)

Enter your answer

Submit
Animal organisation- Gaseous exchange systems Week 4 SUM 2

You should have reviewed the revision pages on the link below before completing this quiz.
https://www.bbc.co.uk/bitesize/guides/zpxv6yc/revision/1

Hi James, when you submit this form, the owner will be able to see your name and email address.

* Required

1. Which of the following is the smallest? *
   - Cell
   - Organ
   - Tissue
   - Organelle

2. Which of the following has the largest surface area to volume ratio? *
   - Elephant
   - Dog
   - Bacteria
   - Ant
3

Because multicellular organisms are larger, they have smaller surface to volume ratios which mean they need specialised organs to speed up the exchange of materials with their environment.

What are the two ways that exchange surfaces in plants and animals are adapted to perform their function? *

(2 Points)

Enter your answer

4

Put the following terms in order to show the path that air takes as it enters the lungs:

Trachea
Bronchiole
Nasal Cavity
Bronchus
Alveoli *

(1 Point)

Enter your answer

5

Which of the following statements is false about the alveoli? *

(1 Point)

- It has a large network of capillaries that cover 70% of its surface that maintain a steep concentration gradient
- It has very good ventilation (air in and out) to maintain a steep concentration gradient
- The are 350 million spherical alveoli in each lung providing a very large surface area
There is a large distance between the capillaries and the air in the alveoli creating a large diffusion distance.

6

What are the main two muscles involved in breathing? *
(2 Points)

Enter your answer

7

Explain why the exchange of gases in fish is very efficient (4 marks) *
(4 Points)

Enter your answer
Animal organisation - Digestion Week

You should have reviewed the revision pages on the link below before completing this quiz
https://www.bbc.co.uk/bitesize/guides/z89mk2p/revision/1

Hi James, when you submit this form, the owner will be able to see your name and email address.

* Required

1

What is the major function of carbohydrates and in what foods can we find them? *
(2 Points)

Enter your answer

2

What is the major function of proteins and in what food can we find them? *
(2 Points)

Enter your answer

3

Which of the following is not made of glucose? *
(1 Point)
4
What are lipids made out of? *
(1 Point)

Enter your answer

5
What are the steps to test for reducing sugars like glucose in the lab? What would a positive result look like? *
(3 Points)

Enter your answer

6
Iodine is used to test for the presence of starch. A positive result will cause the iodine to change colour from orange to blue/black. What are the hazards and safety precautions for this practical? *
(2 Points)
7
Which of the following is not true about the small intestine? *(1 Point)

- Digestive enzymes here continue the digestion of carbohydrates, proteins and lipids
- There are villi to increase the surface area for absorption
- Villi have a short diffusion distance to allow for efficient diffusion of nutrients into the blood
- Contains acid to kill bacteria

8
Enzymes speed up chemical reactions. Explain how amylase breaks down starch. (3 marks) *(3 Points)
9

Explain why enzymes become non functional temperatures beyond the optimum *
(2 Points)

Enter your answer

10

An protease enzyme digests proteins in the stomach.
Suggest the optimum pH of this enzyme and explain your answer. *
(2 Points)

Enter your answer

11

Describe how the liver helps to digest fats. *
(2 Points)

Enter your answer

Submit
Transport in cells Week 3 SUM 2

You should have reviewed the revision pages on the link below before attempting this quiz
https://www.bbc.co.uk/bitesize/guides/zs63tv4/revision/1

Hi James, when you submit this form, the owner will be able to see your name and email address.

* Required

1

Define the term diffusion *
(2 Points)

Enter your answer

2

In the alveoli of the lungs when air is first breathed in, does it have a higher concentration of carbon dioxide than the blood or lower? *
(1 Point)

○ The concentration of carbon dioxide is lower in the alveoli than the blood.

○ The concentration of carbon dioxide is higher in the alveoli than the blood.
3

The concentration gradient is the difference between a high concentration of particles and a low concentration of particles. Select the correct missing words from the sentence below:

"There are three forms of transport, ____________ and ____________ go down the concentration gradient and only ____________ goes against the concentration gradient" *

(1 Point)

☐ Osmosis, Diffusion, Active transport

☐ Active transport, diffusion, Osmosis

☐ Osmosis, Active transport, diffusion

4

Suggest why puppies are more at risk of losing body heat than adult dogs. *

(1 Point)

Enter your answer

5

Define the term osmosis *

(3 Points)

Enter your answer

6

Why do animal cells burst due to osmosis if placed a pure water (a hypotonic solution) but plant cells do not? *

(1 Point)
7

Describe the change which will occur if a piece of peeled potato is placed in a concentrated sugar solution and explain why this change occurs. (3 marks)

*(3 Points)*

---

8

Calculate the percentage change in mass of a potato cylinder that had a mass of: 2.45g before the experiment and 3.21g after being placed in a sugar solution. *

*(1 Point)*

---

9

Plant roots obtain some of their mineral salts from the soil by active transport.

What is involved in active transport? (4 marks) *

*(4 Points)*

---
The image below shows an epithelial cell from the lining of the small intestine. Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food. *
(1 Point)

Enter your answer

Submit
1 Which of the following is not transported by the plasma *
(1 Point)

- Urea
- Hormones
- Antibodies
- Oxygen
- Glucose

2 What prevents the back flow of blood between chambers in the heart? *
(1 Point)

Enter your answer
3
What is the difference between pulmonary circulation and systemic circulation? *
(2 Points)
Enter your answer

4
The image shows three types of blood vessels. Identify the artery and the vein and compare their structure. You may include information from your own knowledge not seen in the diagram *
(5 Points)
Enter your answer

5
Which vessel A, B or C takes blood to the lungs *
(1 Point)

Enter your answer

6
Name part D *
(1 Point)

Enter your answer

7
Name part E *
(1 Point)
If a heart valve is not working it can cause shortness of breath, dizziness, rapid heart rate and chest pain. The problem can lead to heart failure. What are the possible types of replacement valves that doctors can implant surgically? *
(2 Points)

State the four components of the blood and their functions in the body (5 marks) *
(4 Points)
Coronary heart disease is the build up of fatty material called cholesterol in the arteries, this can lead to chest pain then a heart attack which part of the heart muscle or the entire heart can die!
What happens when the blood flow is reduced to the heart to make this happen? *
(2 Points)
Coronary heart disease can be treated by:

- inserting a stent
- using a Coronary Artery Bypass Graft (CABG).

Table 2 gives information about each method.

Give two advantages of using a stent instead of CABG. *(2 Points)*

Enter your answer
Coronary heart disease can be treated by:

- inserting a stent
- using a Coronary Artery Bypass Graft (CABG).

Table 2 gives information about each method.

Give two advantages of using CABG instead of a stent. *
(2 Points)
There is a shortage of donor hearts in the UK. Only around 200 transplants are carried out each year in a small number of hospitals. Why do you think this is? *
(2 Points)

Doctors trialled four different treatments for reducing the risk of heart disease.
Each treatment was trialled on the same number of patients for 5 years. The patients did not have heart disease at the start of the trial.

The graph below shows the results.

How many patients who took aspirin needed treatment for heart disease during the trial? *
(1 Point)
Doctors trialled four different treatments for reducing the risk of heart disease. Each treatment was trialled on the same number of patients for 5 years. The patients did not have heart disease at the start of the trial.

The graph below shows the results.

Based only on the evidence in the graph, which would be the best treatment to reduce the risk of developing heart disease? * (1 Point)
Doctors trialled four different treatments for reducing the risk of heart disease. Each treatment was trialled on the same number of patients for 5 years. The patients did not have heart disease at the start of the trial.

The graph below shows the results.

Suggest one other factor that a doctor might consider before deciding which treatment to use for a patient. * (1 Point)